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(54) **Two-way communications earset with filter**

Zweiweg-Kommunikations-Ohrhörer mit Filter

Casque combiné à deux directions avec filtre

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Description

BACKGROUND OF THE INVENTION

The present invention relates generally to a two-way communications earset with a filter which is worn in or at the ear of the user for use in two-way voice communications and which is operated hands-free. The earset can transmit the user's voice and receive the voice signals of another party simultaneously without causing feedback.

Modern wireless technologies have advanced to the extent that portable, wireless and mobile telephones have become small in size and are used widely. Such portable telephones typically include a handset requiring the use of at least one hand for communication.

A disadvantage of the handset type of telephone is that they are inconvenient to use in front of a computer or while driving a car. In such instances, the user must use a hand to hold the handset while typing at the keyboard, which is very difficult to do, or while holding the steering wheel of a car, which is dangerous. Alternatively, the user must hold the telephone handset to their ear with their shoulder, which is very uncomfortable.

In order to solve this drawback, hands-free telephones have been developed. A conventional two-way communications apparatus used with hands-free telephones comprises a headband including a speaker positioned in front of one ear and a boom attached to the headband with a small microphone at one end of the boom. With the boom connected to the headband, the microphone extends in front of the mouth of the user. However, this type of hands-free telephone is not convenient to use because it is cumbersome and because it disturbs the hair of the user.

Another conventional two-way communications system used with hands-free telephones includes a structure which hangs from the ear of the user. This type of communications system includes a speaker positioned in front of the user's ear and a boom having a microphone extending in front of the mouth of the user. Again, such a structure is not convenient for the user because it typically does not hang well at the ear and because it is bulky to carry owing to the boom.

Yet another conventional two-way communication system comprises a speaker and a microphone both housed in an earset unit which is worn in the ear of the user. Such an earset does not require use of hands to operate and does not have a boom extending in front of the user's mouth. However, a drawback of this earset is that users cannot increase the sound volumes of either the speaker or the microphone. Therefore, the use of this type of earset is limited to quiet environments.

In addition, microphone sensitivity in such conventional earsets is set to a low level. As a result, the user is difficult to hear. Also, because the sensitivity of the speaker is set at a low level as well, the user tends to cover the earset with a hand in order to obtain improved communications in a noisy environment. However, this tends to gauge feedback. Because of these drawbacks, conventional earsets include a warning regarding the tendency for feedback and are not widely used.

Accordingly, an object of the present invention is to provide an earset for use in two-way voice communications which is worn in or at the ear of the user and which is operated hands-free.

Another object of the present invention is to provide an earset which transmits the user's voice and receives voice signals from another party simultaneously without feedback caused by acoustic or mechanical coupling between the speaker and the microphone.

A further object of the present invention is to provide an earset which delivers an adequate level of sound to the user without causing feedback, while also delivering an adequate level of sound to a receiver at the other end of the communication system.

A still further object of the present invention is to provide an earset which includes a mechanical or electrical filter that eliminates audio frequencies tending to cause feedback.

Additional objects and advantages of the invention will be set forth in the description which follows, and in part will be obvious from the description, or may be learned by practice of the invention. The objects and advantages of the invention may be realized and obtained by means of the instrumentalities and combinations particularly pointed out in the appended claims.

SUMMARY OF THE INVENTION

To achieve the objects in accordance with the purposes of the present invention, as embodied and described herein, the earset of the present invention comprises a two-way simultaneous voice transmitting and receiving device comprising a case comprising an enlarged portion adapted to be placed in an ear auricle of a user and a hollow portion extending along a direction away from said enlarged portion, wherein the enlarged portion houses a speaker with an output led to an ear canal of the user and the hollow portion houses a microphone, and means, situated within an audio signal loop coupling the speaker to the microphone, for filtering a high end range of audio frequencies that causes feedback.

The present invention further comprises a two-way simultaneous voice transmitting and receiving device comprising a case including an enlarged portion adapted to be placed in an auricle of a user's ear and a hollow portion extending away from said enlarged portion, wherein the hollow portion houses a microphone, and the enlarged portion houses a speaker with an output to an ear canal of the user, wherein the speaker passes frequencies in a range of 300 to 1000 Hz and has a high end cut off frequency below 2.5 KHz.

Alternatively, the present invention comprises a two-way simultaneous voice transmitting and receiving

device comprising a case including an enlarged portion adapted to be placed in an auricle of a user's ear and a hollow portion extending away from said enlarged portion, wherein the enlarged portion houses a speaker with an output led into an ear canal of the user, and the hollow portion houses a microphone, and wherein the microphone passes frequencies in a range of 300 to 1000 Hz and has a high end cut off frequency below 2.5 KHz.

BRIEF DESCRIPTION OF THE DRAWINGS

The accompanying drawings, which are incorporated in and constitute a part of the specification, illustrate the presently preferred apparatus of the present invention and, together with the general description given abode and the detailed description of the preferred embodiments given below serve to explain the principles of the invention. In the drawings:

Fig. 1 is a side view of an earset according to a first embodiment of the present invention inserted in the ear of a user;
Fig. 2 is sectional view of the first embodiment;
Fig. 3 is a side view of an earset according to a second embodiment of the present invention inserted in the ear of a user;
Fig. 4 is a sectional view of a mechanical filter used in the earset according to the present invention;
Fig. 5A is a circuit diagram of low pass electrical filter used in the earset according to the present invention;
Fig. 5B is a graphical representation of the frequency characteristics of the low pass electrical filter shown in Fig. 5A;
Fig. 6A is a circuit diagram of a band pass electrical filter used in the earset according to the present invention;
Fig. 6B is a graphical representation of the frequency characteristics of the band pass electrical filter shown in Fig. 6A;
Fig. 7 is a graphical representation showing the definition of the cut off frequency within the frequency band without ripple.
Fig. 8 is a graphical representation showing the definition of the cut off frequency within the frequency band with ripple.
Fig. 9A is a block diagram of a frequency compensating filter; and
Fig. 9B is a graphical representation of the frequency characteristics of the compensating electrical filter shown in Fig. 9A.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

A first embodiment of the earset according to the present invention is described with reference to Figs. 1 and 2. As shown in Figs. 1 and 2, the earset 1 has an L-shaped configuration and is preferably made of plastic. The short arm of the L-shaped earset 1 includes an enlarged portion 1a which is inserted in the ear canal of the user. The enlarged portion 1a includes an earset component portion 1b and an insertion portion 1c.

The enlarged portion 1a is placed in the ear auricle of the user and the insertion portion 1c is inserted into the ear canal. The insertion portion 1c is preferably shaped so that the ear canal of the user will not be completely clogged by the device and so that the device will not be so loose that feedback due to leaked sound is caused.

A speaker 3 is housed in the earset component portion 1b and is supported by resilient material 4. The output of the speaker 3 is input to the insertion part 1c and is fed into the ear canal of the user. The speaker 3 can preferably be either a magnetic-type speaker or dynamic-type speaker. As shown in Figs. 1 and 2, the speaker 3 is situated in the earset component portion 1b. However, in accordance with the present invention, the speaker 3 can be placed in an alternate location, so long as the output from the speaker 3 is guided into the ear canal of the user.

The long arm of the L-shaped earset 1 preferably includes a hollow portion 1d which has a small hole 1e at the lower end thereof and an electret type microphone 5 at an upper portion thereof. In accordance with the present invention, the microphone 5 can be either a bidirectional-type or a unidirectional-type microphone. A sound pipe 2 is also contained within the hollow portion 1d and connects the small hole 1e and the microphone 5. In operation, the microphone 5 detects the voice signals of the user through the small hole 1e and the sound pipe 2.

In the embodiment shown in Figs. 1 and 2, a filter 6 is placed within the sound pipe 2 and is situated between the microphone 5 and the small hole 1e. The filter 6 passes audio frequencies within a preferred range of 300 to 1000 Hz with a cut off frequency of preferably below 2.5 KHz, as described in greater detail below. Additionally, as also described in more detail below, the filter 6 can be located at alternate locations in the earset. A wire 7 extends through the hollow portion 1d and combines the wires from the speaker 3 and the microphone 5.

The earset 1 is operated in the following manner. When the earset 1 is situated in the ear of the user, electrical signals which are received are fed via the wire 7 to the speaker 3. The speaker 3 emits sound to the ear canal of the user via a hole 1f in the insertion portion 1c.

The voice signal of the person using the earset 1 passes through the small hole 1e and filter 6 and reaches the microphone 5. The microphone 5 converts the sound to electrical signals that are sent via the wire 7 to an amplifier, which is not shown in Figs. 1 or 2.

Fig. 3 shows a second embodiment of an earset according to the present invention. As shown in Fig. 3, the

device has a two-piece construction including a two-way wireless communication device 8 connected to an earset 1. The communication device 8 includes a transmitter/receiver at the front portion of the ear lobe. The communication device also includes a battery cell located at the back portion of the ear lobe. The battery cell and the transmitter/receiver remain connected to the ear lobe by a pinching mechanism located therebetween. The earset 1, shown in Fig. 3, is substantially the same as that shown in Figs. 1 and 2.

In order to design the earset 1 of the present invention so that it most efficiently conducts two-way voice communications, the unique sound field around the auricle of the ear was studied by the inventors of the present invention. This sound field was found to extend not only in front of the auricle, but also in the area surrounding the auricle and to result from a combination of the sound near the auricle, the ear canal and the head. It was also determined that the sound field generates sound reflection, diffraction and resonance.

As a result of the inventors' study of the sound field, acoustic and mechanical coupling between the speaker 3 and the microphone 5 was determined to increase selectively at a few specific frequencies between 1 KHz and 3.4 KHz. These specific frequencies vary depending on the type of earset worn by the user and the voice characteristics of the user.

It was also observed that when the sound volume of the speaker 3 is increased and when the sensitivity of microphone 5 is increased, feedback tends to occur at the identified specific frequencies. In addition, when the earset 1 is used under heavy ambient noise, the user tends to cover the ear containing the earset 1 with his hand in order to block out the ambient noise. However, such hand placement acts as an ear muff and presents the optimal condition for feedback to occur at these specific frequencies. Feedback between the speaker 3 and the microphone 5 also occurs when a portion of the voice output of speaker 3 is leaked. This leaked portion is reflected off the auricle structure of the ear and input to the microphone 5 via the small hole 1e.

In order to reduce the deleterious affects of acoustic coupling and feedback described above, signals within the area of the specific frequencies are reduced. Although it is well known that reducing signals within a certain frequency range can damage the quality of voice communications, according to the present invention, the specific identified frequencies can be reduced without lowering the quality of voice communications. Additionally, acoustic coupling and feedback can also be significantly reduced.

Specifically with respect to reducing the identified frequencies, the inventors of the present invention found that if he high end cut off frequency was made too low, the quality of voice communications would be unacceptable. Conversely, if the high end cut off frequency was set too high, feedback occurred too readily. The inventors also considered that when sound passes from a free sound field to the ear drum, the sound pressure of signals between 1 KHz to around 2.5 KHz increases.

By balancing the effects of acoustic and mechanical coupling, the likelihood of feedback, and sound pressure with an acceptable level of voice communication, according to the present invention, the filter 6 preferably is configured to pass frequencies in the range of 300 to 1000 Hz and to preferably have a high end cut off frequency of below 2.5 KHz.

Additionally, the filter 6 is situated in the earset 1 in an audio signal loop coupling the speaker 3 and the microphone 5. The audio signal loop is defined as electrical or mechanical connection between the speaker 3 and the microphone 5. By placing the filter anywhere within the audio signal loop, feedback between the speaker 3 and microphone 5 can be substantially reduced.

Several different placements of the filter 6 are contemplated. For example, with the filter 6 coupled to the speaker 3, the speaker 3 will preferably have output characteristics that pass low frequencies in the range of 300 Hz to 1,000 Hz and have a high end cut-off frequency of below 2.5 KHz. Alternatively, with the filter 6 coupled to the microphone 5, electrical signals from the microphone 5 will preferably have signal characteristics that pass low frequencies in the range of 300 Hz to 1,000 Hz and have a high end cut-off frequency of below 2.5 KHz. And alternatively, two or more filters with portions of the desired frequency response can be allocated between the speaker 3 and microphone 5 in the audio signal loop.

In addition to reducing acoustic coupling and feedback and producing an acceptable voice signal, it is desirable that the earset 1 in of the present invention be sensitive to human voice signals, but not to ambient noise or noise that is leaked from the speaker 3. Because the earset 1 is small in size and is mounted at the entrance of the ear canal of the user, it is preferable that the earset 1 have a structure which provides a greater sensitivity to voice signals and a lesser sensitivity to sound reaching the earset 1 from other directions.

To achieve this result, mechanical filter 61 is used to improve the directional sensitivity of the earset 1. Fig. 4 is a side view of a mechanical filter 61 which may be employed in the earset 1 shown in Figs. 1-3. As shown in Fig. 4, the filter 61 is preferably made of a fiber sheet coiled so that the sheet fits into the cylindrically shaped hollow portion 1d.

Preferably, the filter 61 comprises a coil of highly fibrous paper tightly wound and filling the hollow portion 1d, which preferably has a diameter of 6 mm. The mechanical filter 61 is constructed so that it has the frequency characteristics described above. The resultant frequency characteristic can be varied by changing the density of the coil, ie., reducing the number of coils.

With such a coiled structure, sound coming from a direction parallel to the axis of the mechanical filter 61 passes through to microphone 5 with less attenuation

than sound coming from other directions. Because voice signals coming from the user primarily emanate along an axis parallel to the axis of the mechanical filter 61, these signals are less attenuated than those of other signals reaching the microphone 5 and the sensitivity to voice signals is therefore improved.

In the embodiment of the mechanical filter 6 shown in Fig. 4, the structure of the coiled fiber sheet achieves the desired frequency response and improves the sensitivity of the earset 1 to voice signals. Alternatively, the mechanical filter 61 may be constructed of glass wool, rock wool, felt, materials such as high density sponge, or fibres made of cotton and pulp. More specifically, the mechanical filter 61 may comprise a cigarette filter because it has been found that cigarette filters can achieve the desired frequency characteristics. Additionally, a cigarette filter fits within the hollow portion 1d and are readily available.

It should also be noted that Figs. 1 and 2 show an embodiment in which a mechanical filter 6 is positioned in front of microphone 5. However, as discussed above, a mechanical filter 6 with a similar frequency response can alternatively be placed in front of the speaker 3. It is also contemplated that a first mechanical filter 6 with a portion of the desired filter characteristics be placed in front of the microphone 5 while another mechanical filter 6, having another portion of the desired frequency response, be positioned in front of the speaker 3.

Alternatively, the filter 6 may preferably comprise electrical components, as shown in Figs. 5A and 6A. Fig. 5A shows a low pass filter 62 comprising an operational amplifier 9 which can be used as the filter 6 of the earset 1. Fig. 6A shows a band pass filter 63 also comprising an operational amplifier 10 which can be used as the filter 6 of the earset 1. Fig. 5B and Fig. 6B show the frequency responses of the filters shown in Fig. 5A and Fig. 6A, respectively.

Preferably, the operational amplifier may comprise a National Semiconductor LM324 type operational amplifier although alternative devices are known or can be designed by those of ordinary skill in the art. Additionally, as described with the mechanical filter 61, the low pass filter 62 and the band pass filter 63 are preferably placed in the audio loop between the speaker 3 and the microphone 5.

As described above, according to the present invention, the high end cut off frequency of the filter 6 is preferably below 2.5 KHz. When one of the low pass filter 62 or the band pass filter 63 are used as the filter 6 of the earset 1, a determination of the high end cut off frequency is made depending on the characteristics of the filter 6. That is, the high end cut off frequencies for a frequency band with or without amplitude ripple, as shown in Fig. 7 and Fig. 8, respectively, will be different.

More specifically, in accordance with the present invention, the high end cut off frequency of the low pass or band pass filters 62 and 63 shown, respectively, in Figs. 5A and 6A is defined such that if the filter 6 does not have a ripple characteristic within the frequency range allowed to pass therethrough, as shown in Fig. 7, the cut-off frequency of the filter 6 is defined as that after which an output from the filter 6 becomes 3 dB below the maximum amplitude within the allowable frequency range. Alternatively, if the filter 6 does have a ripple characteristic within the frequency range allowed to pass therethrough, as shown in Fig. 8, the cut-off frequency is defined as that frequency after which an output from the filter 6 becomes 3 dB below the average amplitude within the allowed frequency range.

However, constructed as shown in Figs. 5A and 6A, the filters 62 and 63, may cut off certain high frequency components of the speech signals and may therefore deteriorate voice communications. In order to make up for this, an alternative filter 64 which includes a compensating circuit can be used.

Fig. 9A is a circuit diagram of such a compensation filter 64. The compensating filter 64 shown in Fig. 9A, improves the loss of high frequencies which may be filtered out by filters 62 and 63, shown in Figs. 5A and 6A. Fig. 9B is a graphical representation of the frequency response of the circuit shown in Fig. 9A.

More specifically, in operation, the microphone 5 of the earset 1, shown in Figs. 1-3, produces an electrical signal output 6a. Output 6a is fed into audio band limiting filter 6b which as shown in Fig. 9B produces a band pass filter response similar to that shown in Fig. 6B. It is also contemplated that the output 6a can emanate from the speaker 3.

The output 6a is also input to high end audio select filter 6cl of the high end audio amplitude limiter 6c. The high end audio select filter 6c1 passes selected high end audio frequencies. The frequency response of the high end audio select filter 6c1 is shown in Fig. 9B. The output of the high end audio select filter 6cl is fed into amplitude limiter 6c2 which limits the output of the high end audio select filter to a predetermined level. The output of the amplitude limiter 6c2 is fed into attenuator 6d. The outputs of audio band limiting filter 6b and attenuator 6d are added by the adder 6e.

A graphical representation of the frequency response of the filter 64, shown in Fig. 9A, is shown in Fig. 9B. The frequency response includes the both the 6b characteristics, the output from the audio band limiting filter, and the 6c1 characteristics, the output from the attenuator 6d. Accordingly, with the filter 64 of the present invention, the amplitudes of high frequencies are controlled below a certain level by amplitude limiter 6c2 so that feedback will not occur. In addition, because some high frequencies are left in the resultant output signal, as a result of the addition of high end signals to those of the audio band limiting filter 6b, the resultant voice signal will not be deteriorated.

Other embodiments of the invention will be apparent to those skilled in the art from consideration of the specification and practice of the invention disclosed herein. It is intended that the specification and examples

be considered as exemplary only, with the scope of the invention being indicated by the following claims.

Claims

1. A two-way simultaneous voice transmitting and receiving device comprising:

   a case (1) comprising an enlarged portion (1a) adapted to be placed in an ear auricle of a user and a hollow portion (1d) extending along a direction away from said enlarged portion, wherein the enlarged portion houses a speaker (3) with an output led to an ear canal of the user and the hollow portion houses a microphone (5); and
   means (6, 61, 62, 63, 64), situated within an audio signal loop coupling the speaker (3) to the microphone (5), for filtering a high end range of audio frequencies that causes feedback.

2. The two-way simultaneous voice transmitting and receiving device according to claim 1, wherein the filter means comprises one of a low pass filter (62) and a band pass filter (63) and passes audio frequencies in a range of 300 Hz to 1000 Hz and has a high end cut off frequency of below 2.5 KHz.

3. The two-way simultaneous voice transmitting and receiving device according to claim 2, wherein the high end cut off frequency is defined such that if the filter does not have a ripple characteristic within an allowable frequency range, the high end cut off frequency is a frequency after which the output of the filter (62, 63) is less than 3 dB below a maximum amplitude of the allowable frequency range, and if the filter has a ripple characteristic within the allowable frequency range, the high end cut off frequency is a frequency after which the output of the filter is less than 3 dB below an average amplitude of the allowable frequency range.

4. The two-way simultaneous voice transmitting and receiving device according to claim 1, wherein the filter means (6) comprises sound absorbing material positioned in an area between a sound intake hole (1e) in the hollow portion (1d) and a diaphragm of the microphone (5).

5. The two-way simultaneous voice transmitting and receiving device according to claim 4, wherein the sound absorbing material is situated in the space between the sound intake hole (1e) and the diaphragm of the microphone (5) and provides sound directivity to voice signals of the user.

6. The two-way simultaneous voice transmitting and receiving device according to claim 4, wherein the sound absorbing material comprises one of a coiled fiber sheet, glass wool, rock wool, felt, a high density sponge, cotton fibers and pulp fibers.

7. The two-way simultaneous voice transmitting and receiving device according to claim 2, wherein the filter means (64) comprises:

   a high end audio select filter (6c1), connected to the microphone (5), which passes high end audio frequencies and which outputs a first signal with an amplitude;
   an amplitude limiter (6c2), coupled to the high end audio select filter, which limits the amplitude of the first signal output from the high end audio select filter below a predetermined level;
   an audio band limiting filters (6b), connected to the microphones (5), which bypasses the high end audio select filter and the amplitude limiter and outputs a second signal; and
   an adder (6e), coupled to the audio band limiting filter and to the amplitude limiter, for adding the first and second signals.

8. A two-way simultaneous voice transmitting and receiving device comprising a case (1) including an enlarged portion (1a) adapted to be placed in an auricle of a user's ear and a hollow portion (1d) extending away from said enlarged portion, wherein

   the hollow portion houses a microphone, and the enlarged portion houses a speaker (3) with an output to an ear canal of the user, wherein the speaker passes frequencies in a range of 300 to 1000 Hz and has a high end cut off frequency below 2.5 KHz.

9. A two-way simultaneous voice transmitting and receiving device comprising a case (1) including an enlarged portion (1a) adapted to be placed in an auricle of a user's ear and a hollow portion (1d) extending away from said enlarged portion, wherein

   the enlarged portion houses a speaker (3) with an output led into an ear canal of the user, and the hollow portion houses a microphone (5), and wherein the microphone passes frequencies in a range of 300 to 1000 Hz and has a high end cut off frequency below 2.5 KHz.

Patentansprüche

1. Zweiweg-Stimmen-Sendeempfangsgerät mit:

   einem Gehäuse (1) mit einem vergrößerten Teil (1a), das zum Anordnen in einem Ohrlappen ei-

nes Benutzers angepaßt ist, und einem hohlen Teil (1d), das sich längs einer von dem vergrößerten Teil fortweisenden Richtung erstreckt, wobei der vergrößerte Teil einen Lautsprecher (3) mit einem sich zum Ohrkanal des Benutzers führenden Auslaß und der hohle Teil ein Mikrophon (5) beherbergt, und

einer Einrichtung (6, 61, 62, 63, 64), die in einer Audiosignalschleife angeordnet ist und den Lautsprecher (3) mit dem Mikrophon (5) koppelt, um den hohen Endbereich der Audiofrequenzen, der eine Rückkopplung bewirkt, zu filtern.

2. Zweiweg-Stimmen-Sendeempfangsgerät nach Anspruch 1, wobei die Filtereinrichtung eines aus einem Tiefpaßfilter (62) und einem Bandpaßfilter (63) aufweist und Audiofrequenzen in einem Bereich von 300 Hz bis 1000 Hz hindurchläßt und eine Abschneidefrequenz am hohen Ende von unter 2,5 KHz hat.

3. Zweiweg-Stimmen-Sendeempfangsgerät nach Anspruch 2, wobei die Abschneidefrequenz des hohen Endes derart definiert ist, daß, wenn das Filter keine Welligkeitskennlinie innerhalb eines zulässigen Frequenzbereiches hat, die Abschneidefrequenz am hohen Ende eine Frequenz ist, nach der das Ausgangssignal des Filters (62, 63) geringer als 3 dB unterhalb einer maximalen Amplitude des zulässigen Frequenzbereichs ist, und, wenn das Filter eine Welligkeitskennlinie innerhalb des zulässigen Frequenzbereiches hat, die Abschneidefrequenz am hohen Ende eine Frequenz ist, nach der das Ausgangssignal des Filters geringer als 3 dB unterhalb einer gemittelten Amplitude des zulässigen Frequenzbereiches ist.

4. Zweiweg-Stimmen-Sendeempfangsgerät nach Anspruch 1, wobei die Filtereinrichtung (6) ein schallabsorbierendes Material aufweist, das in einem Bereich zwischen einer Schallaufnahmeöffnung (1e) in dem hohlen Teil (1d) und einer Membran des Mikrophons (5) angeordnet ist.

5. Zweiweg-Stimmen-Sendeempfangsgerät nach Anspruch 4, wobei das schallabsorbierende Material in einem Raum zwischen der den Schall aufnehmenden Öffnung (1e) und der Membran des Mikrophons (5) angeordnet ist und eine Schallrichtwirkung für Stimmsignale des Benutzers bewirkt.

6. Zweiweg-Stimmen-Sendeempfangsgerät nach Anspruch 4, wobei das schallabsorbierende Material eines aus einem gewickelten Faserblatt, Glaswolle, Steinwolle, Filz, einem hochdichten Schwamm, Baumwollfasern und Papierfasern aufweist.

7. Zweiweg-Stimmen-Sendeempfangsgerät nach Anspruch 2, wobei die Filtereinrichtung (64) aufweist:

ein Audioauswahlfilter (6c1), das mit dem Mikrophon (5) verbunden ist, Audiofrequenzen am hohen Ende hindurchläßt und ein erstes Signal mit einer Amplitude abgibt;

einen Amplitudenbegrenzer (6c2), das mit dem Audioauswahlfilter für das hohe Ende gekoppelt ist, die Amplitude des ersten Ausgangssignals von dem Audioauswahlfilter unter einen vorbestimmten Pegel begrenzt;

ein Audio-Bandbegrenzungsfilter (6b), das mit dem Mikrophon (5) verbunden ist, das Audioauswahlfilter und den Amplitudenbegrenzer überbrückt und ein zweites Signal abgibt, und

einen Addierer (6e), der mit dem Audio-Bandbegrenzungsfilter und dem Amplitudenbegrenzer gekoppelt ist, um die ersten und zweiten Signale zu addieren.

8. Zweiweg-Stimmen-Sendeempfangsgerät mit einem Gehäuse (1), das einen vergrößerten Teil (1a), das zum Anordnen in einem Ohrlappen eines Benutzers angepaßt ist, und einen hohlen Teil (1d) umfaßt, das sich längs einer von dem vergrößerten Teil fortweisenden Richtung erstreckt, wobei der hohle Teil ein Mikrophon und der vergrößerte Teil einen Lautsprecher mit einem zum Ohrkanal des Benutzers führenden Auslaß beherbergt, wobei der Lautsprecher Frequenzen in einem Bereich von 300 bis 1000 Hz hindurchläßt und eine Abschneidefrequenz an einem hohen Ende unter 2,5 KHz hat.

9. Zweiweg-Stimmen-Sendeempfangsgerät mit einem Gehäuse (1), das einen vergrößerten Teil (1a), das zum Anordnen in einem Ohrlappen eines Benutzers angepaßt ist, und einen hohlen Teil (1d) umfaßt, das sich längs einer von dem vergrößerten Teil fortweisenden Richtung erstreckt, wobei der vergrößerte Teil einen Lautsprecher (3) mit einem zum Ohrkanal des Benutzers führenden Auslaß und der hohle Teil ein Mikrophon (5) beherbergt, wobei das Mikrophon Frequenzen in einem Bereich von 300 bis 1000 Hz hindurchläßt und eine Abschneidefrequenz an einem hohen Ende unter 2,5 KHz hat.

Revendications

1. Dispositif d'émission et de réception bidirectionnelles simultanées de voix comprenant:

- un boîtier (1) comprenant une partie agrandie (1a) adaptée pour être placée dans l'auricule

d'une oreille d'un utilisateur et une partie creuse (1d) s'étendant le long d'une direction s'éloignant de ladite portion agrandie, dans laquelle la partie agrandie loge un haut-parleur (3) avec une sortie conduisant au canal auriculaire de l'utilisateur et la partie creuse loge un microphone (5); et

- un moyen (6, 61, 62, 63, 64), situé dans une boucle de signal auditif couplant le haut-parleur (3) au microphone (5) pour filtrer une gamme de hautes fréquences auditives qui provoquent une rétroaction.

2. Dispositif d'émission et de réception bidirectionnelles simultanées de voix selon la revendication 1, dans lequel le moyen de filtre comprend un filtre d'un filtre passe-bas (62) et d'un filtre passe-bande (63) et laisse passer les fréquences auditives dans une gamme de 300 Hz à 1 000 Hz et possède une fréquence de coupure haute inférieure à 2,5 kHz.

3. Dispositif d'émission et de réception bidirectionnelles simultanées de voix selon la revendication 2, dans lequel la fréquence de coupure haute est définie de sorte que si le filtre n'a pas de caractéristique d'ondulation dans une gamme de fréquences admissibles, la fréquence de coupure haute est une fréquence au delà de laquelle la sortie du filtre (62, 63) est plus faible de 3 dB par rapport à une amplitude maximale dans la gamme de fréquences admissibles, et si le filtre possède une caractéristique d'ondulation dans la gamme de fréquences admissibles, la fréquence de coupure haute est une fréquence au delà de laquelle la sortie du filtre est plus faible de 3 dB par rapport à une amplitude moyenne dans la gamme de fréquences admissibles.

4. Dispositif d'émission et de réception bidirectionnelles simultanées de voix selon la revendication 1, dans lequel le moyen de filtre (6) comprend une matière absorbant le son disposé dans une zone entre un trou de prise de son (1e) dans la partie creuse (1d) et un diaphragme du microphone (5).

5. Dispositif d'émission et de réception bidirectionnelles simultanées de voix selon la revendication 4, dans lequel la matière absorbant le son est située dans l'espace compris entre le trou de prise du son (1e) et le diaphragme du microphone (5) et fournit une directivité du son aux signaux vocaux de l'utilisateur.

6. Dispositif d'émission et de réception bidirectionnelles simultanées de voix selon la revendication 4, dans lequel la matière absorbant le son comprend un élément d'une feuille de fibre bobinée, de laine de verre, de laine de roche, de feutre, d'éponge à densité élevée, de fibres de coton et de fibres de pâte à papier.

7. Dispositif d'émission et de réception bidirectionnelles simultanées de voix selon la revendication 2, dans lequel le moyen de filtre (64) comprend:

- un filtre (6c1) de sélection de hautes fréquences auditives, relié au microphone (5), qui laisse passe les hautes fréquences auditives et qui produit un premier signal avec une certaine amplitude;
- un limiteur d'amplitude (6c2), couplé au filtre de sélection de hautes fréquences auditives, qui limite l'amplitude de la première sortie de signal provenant du filtre de sélection de hautes fréquences auditives au-dessous d'un niveau prédéterminé;
- un filtre limitant une bande auditive (6b), relié au microphone (5), qui effectue une dérivation sur le filtre de sélection de hautes fréquences et le limiteur d'amplitude et qui produit un deuxième signal; et
- un additionneur (6e), couplé au filtre limitant une bande auditive et au limiteur d'amplitude, pour additionner les premier et deuxième signaux.

8. Dispositif d'émission et de réception bidirectionnelles simultanées de voix comprenant un boîtier (1) comprenant une partie agrandie (1a), adaptée pour être placée dans un auricule de l'oreille d'un utilisateur et une partie creuse (1d) s'étendant en s'éloignant de ladite partie agrandie, dans lequel:

- la partie creuse loge un microphone (5); et
- la partie agrandie loge un haut-parleur (3) avec une sortie vers un canal auriculaire de l'utilisateur, dans laquelle le haut-parleur laisse passe les fréquences dans une gamme de 300 à 1 000 Hz et qui possède une fréquence de coupure haute au-dessous de 2,5 kHz.

9. Dispositif d'émission et de réception bidirectionnelles simultanées de voix comprenant un boîtier (1) comprenant une partie agrandie (1a) adaptée pour être placée dans un auricule de l'oreille d'un utilisateur et une partie creuse (1d) s'étendant en s'éloignant de ladite partie agrandie, dans lequel:

- la partie agrandie loge un haut-parleur (3) avec une sortie conduisant dans le canal auriculaire de l'utilisateur; et
- la partie creuse loge un microphone (5), et dans lequel le microphone laisse passer les fréquences dans une gamme de 300 à 1 000 Hz et possède une fréquence de coupure haute au-dessous de 2,5 kHz.

Fig. 1

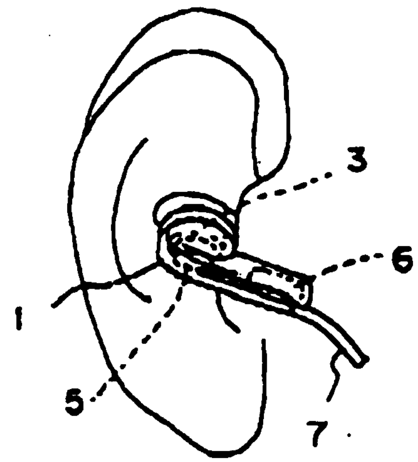


Fig.2

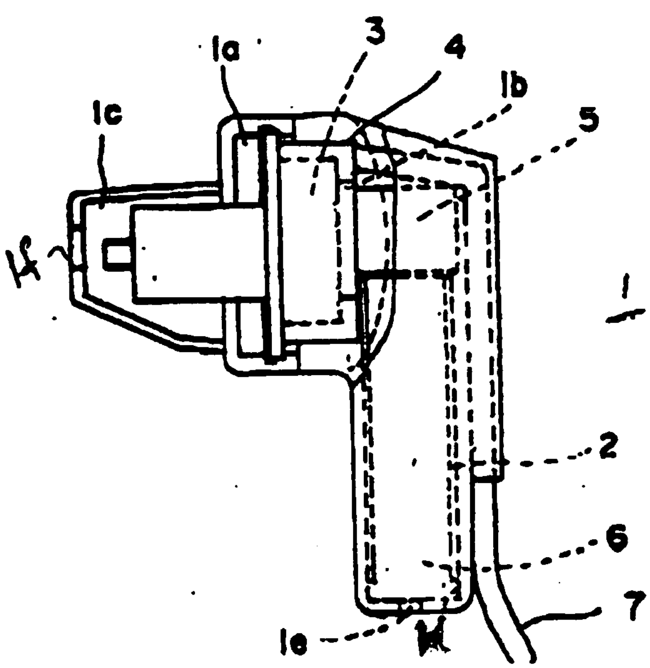


Fig. 4

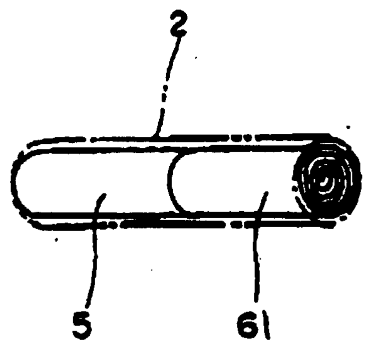


Fig. 3

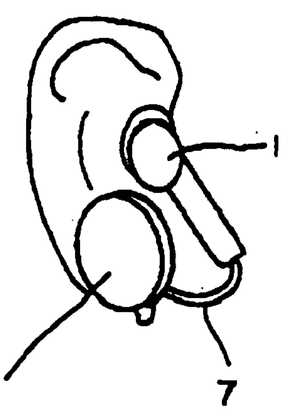
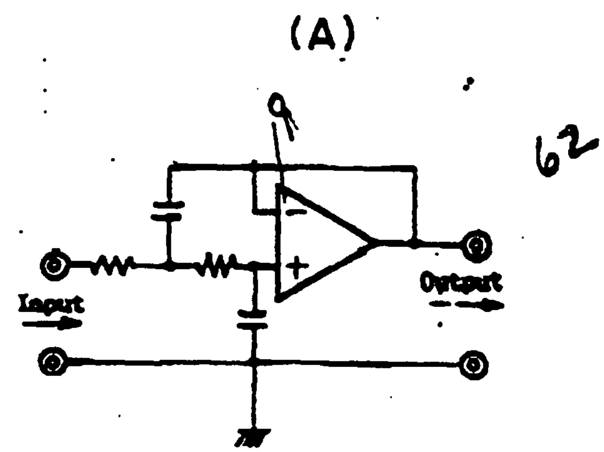
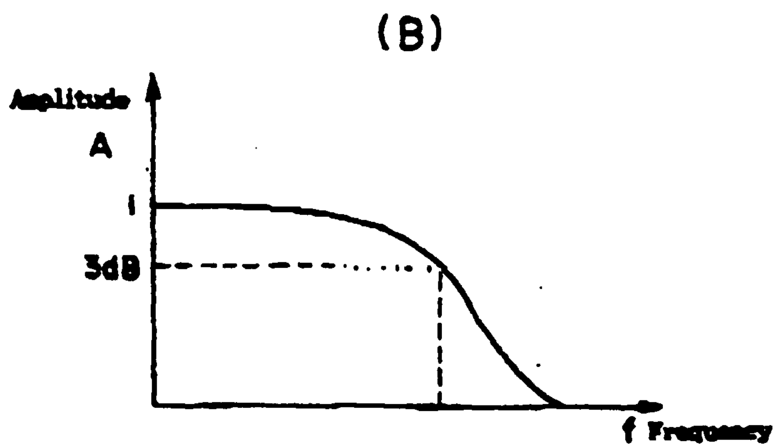


Fig.5





High-end Cut-off Frequency

Fig.6

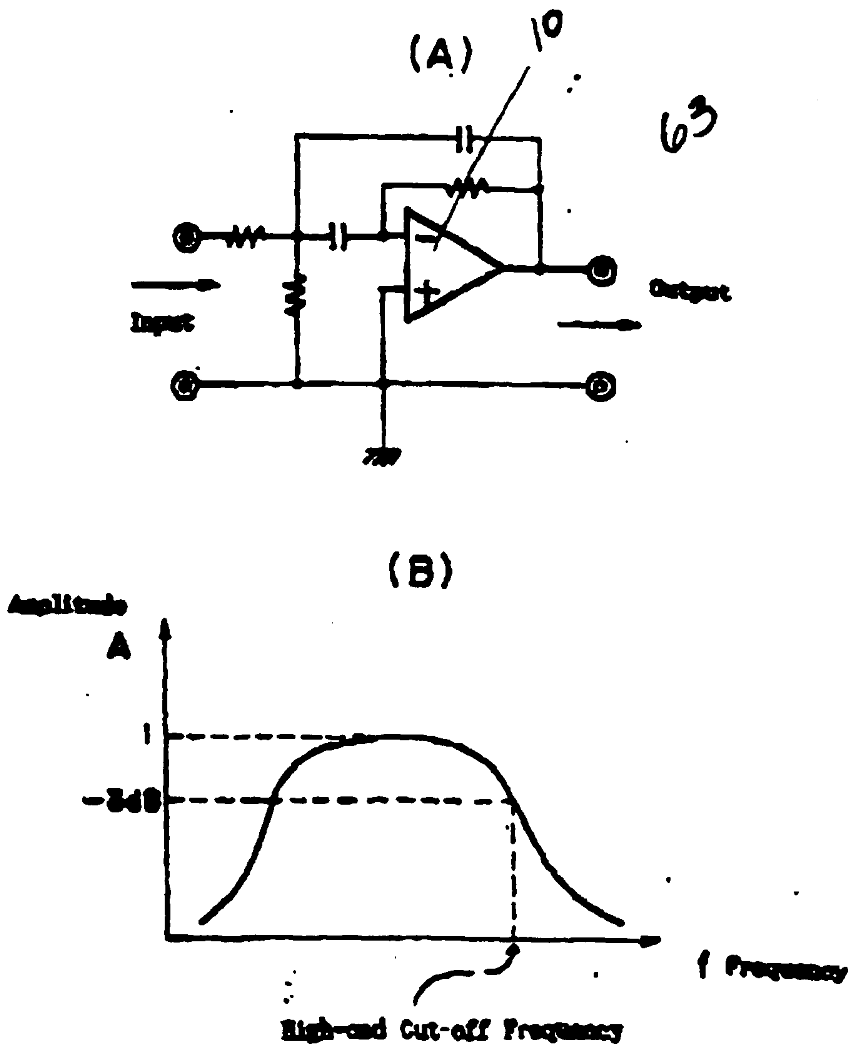

(A)
10
63
Input
Output
(B)
Amplitude
A
1
-3dB
f Frequency
High-end Cut-off Frequency

Fig.7

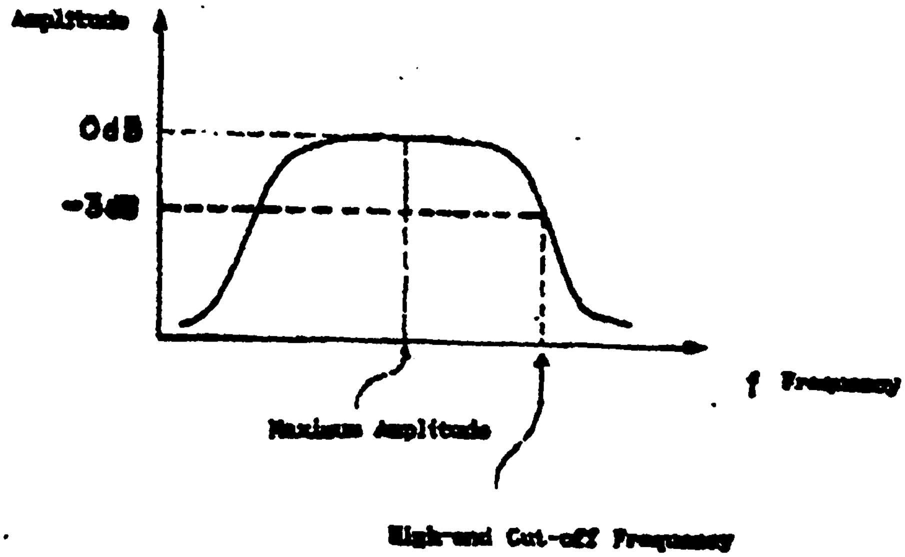

Amplitude
0dB
-3dB
f Frequency
Maximum Amplitude
High-end Cut-off Frequency

Fig.8

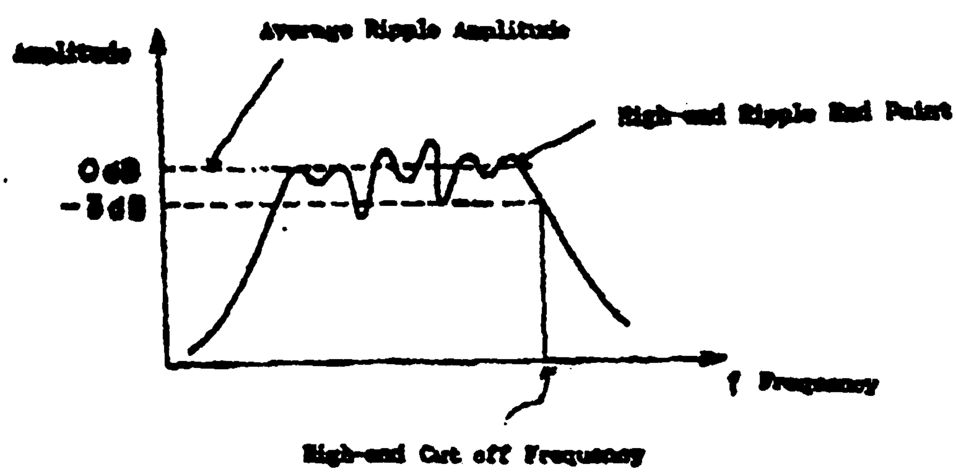
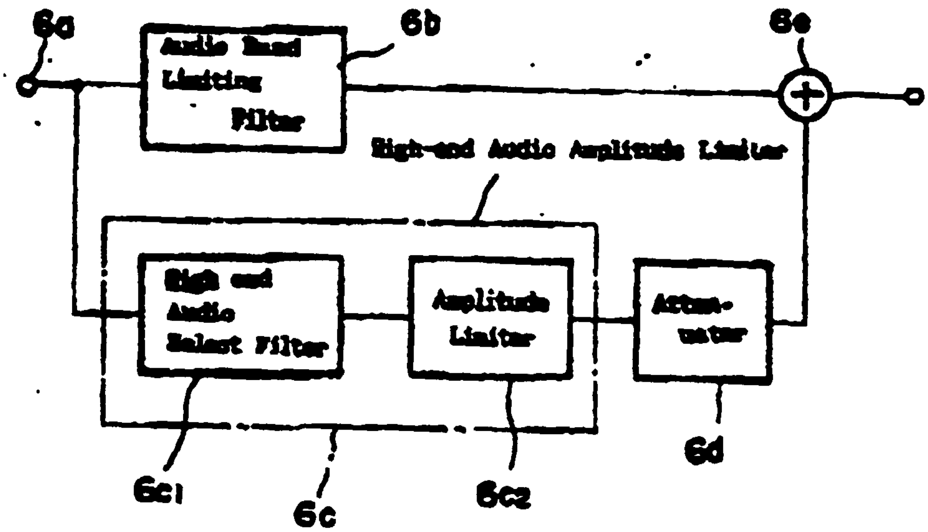
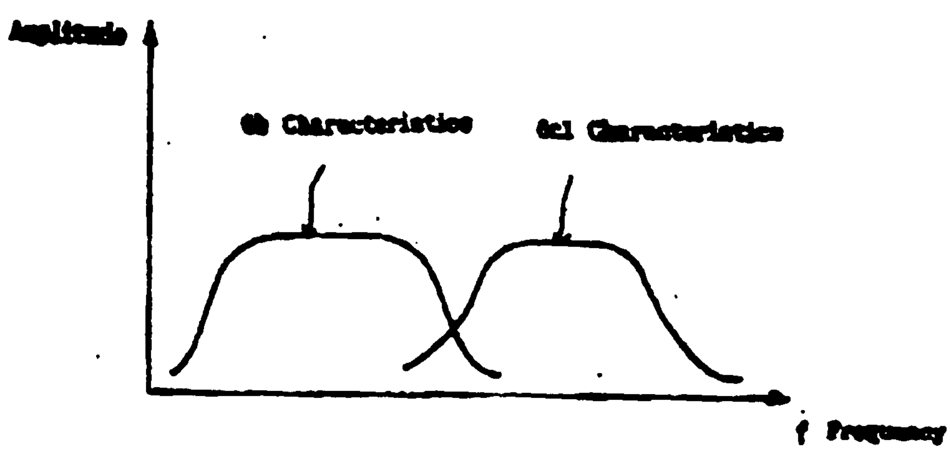

Average Ripple Amplitude
Amplitude
High-end Ripple End Point
0dB
-3dB
f Frequency
High-end Cut off Frequency

Fig.7

(A)


6a
Audio Band Limiting Filter
6b
6e
High-end Audio Amplitude Limiter
High end Audio Select Filter
Amplitude Limiter
Attenuator
6d
6c1
6c
6c2

(B)


Amplitude
6b Characteristics
6c1 Characteristics
f Frequency